

I claim:

1 1. A compact electrically and optically pumped multiwavelength nanocavity array
 2 comprising a plurality of nanocavities, each nanocavity defined in a photonic crystal
 3 in which each nanocavity is lithographically formed to define a corresponding
 4 predetermined spectral response of each nanocavity, said plurality of nanocavities
 5 forming said array.

1 2. The array of claim 1 where said spectral response which is lithographically
 2 formed defines wavelength supported by said nanocavity.

1 3. The array of claim 1 where said spectral response which is lithographically
 2 formed defines polarization supported by said nanocavity.

1 4. The array of claim 1 where said spectral response which is lithographically
 2 formed defines polarization and wavelength supported by said nanocavity.

1 5. The array of claim 1 wherein said array is a laser array.

1 6. The array of claim 1 wherein said array is a detector array.

1 7. The array of claim 1 wherein said array is an all optical gate.

1 8. The array of claim 1 wherein said array is an all optical router.

1 9. The array of claim 1 wherein said array is a modulator.

1 10. The array of claim 1 wherein said photonic crystal is formed in active quantum
2 well material.

1 11. The array of claim 1 wherein said nanocavities are vertical cavity surface emitting
2 lasers, VCSELs.

1 12. The array of claim 11 wherein said nanocavities each have a size and wherein
2 said size of each of said nanocavities is approximately a cubic half-wavelength.

1 13. The array of claim 1 said array is an array of lasers and where at least one
2 nanocavity laser is used as a pump for an adjacent nanocavity laser.

1 14. The array of claim 1 further comprising a nonlinear optical material filling said
2 photonic crystal.

1 15. The array of claim 14 wherein said array is a tunable nanocavity laser, detector,
2 router, gate or spectrometer array.

1 16. The array of claim 14 further comprising means for changing optical or electrical
2 properties of said nonlinear optical material in each of said nanocavities.

1 17. The array of claim 1 where said photonic crystals in said array are defined in Si-
2 Ge materials on silicon substrates disposed on insulators.

1 18. The array of claim 17 further comprising a silicon slab waveguide or integrated
2 circuit integrated with said array.

1 19. The array of claim 17 further comprising a nonlinear optical material filling said
2 photonic crystal and means for changing optical or electrical properties of said
3 nonlinear optical material in each of said nanocavities.

1 20. The array of claim 1 further comprising a waveguiding layer disposed adjacent to
2 said array, said waveguiding layer being transparent to light from said array and is
3 critically coupled to said nanocavities in said array.